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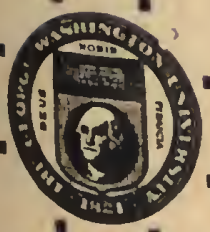

THE GEORGE WASHINGTON UNIVERSITY
SCHOOL OF ENGINEERING

★ ON ENGINEERING RESEARCH

★ GRAND REGENT AMES

★ THE COLUMBIA RIVER RECLAMATION PROJECT

★ LONG PLAYING RECORDS

★ ECONOMY IN PIG IRON PRODUCTION

★ FINAL EXAMINATIONS

MARCH 1949

MECHELECIV

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ON ENGINEERING RESEARCH

By A. E. Orebaugh

Thousands of industries today use engineers in performing many phases of engineering work. Some of these are design, development, testing, management, "trouble shooting", research, etc. One of these which has been given more attention in recent years is research. This is emphasized by the expanding research programs instigated by the government, General Electric Co., General Motors Corporation, etc. Because of these expanded programs many of us will, upon graduation, find ourselves dong this type of engineering work.

The chief object of a research laboratory is to probe for new facts and to have them ready to help develop new markets and retain old ones. While industrial research is scientific and is conducted largely in a laboratory, it is essentially a part of the selling process. It helps you find out for sure new facts about what you have to sell. By discovering new attributes in an old material you can keep present customers satisfied and gain the information you need to sell in ever-widening markets.

A modern research organization must have at least three basic requirements. These are qualified men, organized in a working team; adequate sources of information; and suitable physical facilities.

A working team of qualified men should include research engineers and nonresearch workers. Under nonresearch workers is found test engineers, mechanics, draftsmen, clerks, and assistants of various kinds. One of the requirements for research engineers is an analytical type of mind and training in mathematics. physics and chemistry. An understanding of basic engineering phenomena is also needed qualification. Another requirement is specialization in at least one field for greatest usefulness. Most necessary specialties are thermodynamics, heat transfer, fluid mechanics, mechanics of solid bodies, stress and strain resistance of materials, corrosion resistance, and metallurgy. A third requirement is previous experience as a test engineer.

Sources of information can never be too great. Important information may often be obtained from indirect sources and consequently selected reading of seemingly unrelated subjects is desirable and sometimes necessary.

All engineers should know how to use a library. Some of the typical or usual sources of information available in libraries are book references, including engineering handbooks; reports of societies, institutions, and governmental agencies; company records; professional society papers; industrial catalogs; and patents.

Suitable physical facilities should include a laboratory, with library, calculating and drafting room, stores, and shop equipment.

Research is initiated by a statement of the problem passed down to the research department. The channels followed from the source of the statement to the research department are dependent upon the organization of the particular company. When the problem is received it is then discussed with the source to clarify it so that it will be known exactly what is to be done. The problem is then broken down into smaller or subproblems that can stand by themselves. This not only helps to clarify the problem, but may save time by permitting concurrent solutions of the subproblems.

The problem can now be analyzed to determine the extent to which new effort, especially of the experimental sort, is necessary. This is done by means of literature reference search. calculations, and analysis. When this analysis is completed, the part that must be solved by experimentation will be known.

Next. a description and sketches of the setup for experimentation must be prepared showing the details so completely that any qualified person can make the complete assembly of what is needed for the observations to be made. An estimate may also be made of the probable time and cost necessary to complete the project.

The foregoing steps constitute the preliminary report. When they have been completed and approved the actual work of solving the problem may begin according to th description in the preliminary report. This includes the collection of test data. calculations, and finally, a conclusion must be drawn and some sort of reasoned interpretation of the results made.

GRAND REGENT AMES

By N. C. Hekimian

The new Grand Regent of Theta Tau, National Professional Engineering Fraternity, is Norman B. Ames, Professor of Electrical Engineering at the George Washington University. "Deacon Ames", as he is known to the students, has been a Theta Tau of Gamma Beta Chapter for fourteen years. Previous to the National Convention at the Knickerbocker Hotel in Chicago last December he was serving the fraternity as Grand Vice Regent.

Theta Tau, with 24 chapters coast to coast. is dedicated to developing a high standard of professional interest among its members, and to uniting them in a strong hond of fraternal fellowship. It is not a scholastic honorary fraternity, but instead it recognizes leadership and sociability as well as scholarship to be important qualities of a succesful professional man.

Professor Ames, who also is a member of Sigma Tau, Delta Tau Delta, and Omicron Delta Kappa Fraternities, attended Mississippi State where he received a B.S. in E.E. degree in 1915.

He took a job as electrical draftsman at The Washington Navy yard attending GW in the evening, and completed requirements for another B.S. in E.E. during the summer of 1916. He then went on to M.I.T. receiving a third B.S. in E.E., jointly from M.I.T. and Harvard in June 1917. World War one intervened after which he was lured back to G.W. in 1920 to a life of teaching. At G.W. he received an LL.B. in 1925 and a professional degree in E.E. in 1929. The fall of 1932 and the summer of 1933 were spent at M.I.T. where he received a Master of Science degree in 1935.

On March 16, 1935 he became a charter member of the new Gamma Beta chapter of Theta Tau at G.W. Since then, as well as being Gamma Beta's faculty adviser, he has held the positions of Grand Outer Guard, Grand Inner Guard, and Grand Vice Regent.

A year before Pearl Harbor the "Deacon" went to war, and five years later he came hack a Colonel in the Air Corps. Those who have been in his classes know he is engaged in politics in Montgomery County, Maryland. He was an Elected Member and Chairman of the Charter Board in Nov. 1946 which wrote the present charter. It was adopted in Nov. 1948. At the time he was president of the Charter Committee. He has his own unprintable opinion of the Russians, which most of us are coming to share more every day.

As Grand Regent of Theta Tau his responsibilities include making a biannual visit to each of the 24 chapters to strengthen their national bond. His first big task will be one of colonization, the enlarging and expanding of the fraternity.

Theta Tau has been able to withstand wars. economic depressions, and a current racial problem, things which too often bring about the collapse of other fraternities. These same problems and others will confront us in the future. making the job of Grand Regent extremely important. No other person is in a better position to further the cause of brotherhood in professional engineering, so good luck to you, Professor Ames.

And by the way, if the handle of "Deacon" is dropped, it's not that our professor"s gone high hat on us. It's just that two years ago his daughter made him a Grandpa, and last year the church made him an Elder.

THETA TAU

A second initiation was held last semester in Lisner, followed that night by a semi-Dogpatch style dance at the Cameron Club. Initiates were: William Allison, Ken Brown, Sr., Harry Crosswell, Howard Grayson, Ray Juncal, Fred Lewis. John Melhope, William Riner, Frank Thompson. George Titrington, and Bill Whittemore.

Adhering to the old custom, candlesticks for new family additions were presented to the Hillis McGees, proud parents of a bouncing baby girl. Among the alumni present was Vince Hennessey who passed in and out, but John Lewis (not alumnus yet) just passed out. He, of course, was bartender.

New officers for this semester are: Claude Dimmettee replacing Jim Sinsahaugh as Treasurer, Jim Robbins replacing Merrit Downing as Corresponding Secretary, and George Titrington in the new joh of Assistant Treasurer.

Orchids to Deacon Ames, new Grand Regent of Theta Tau, and to Don Blanchard, Outstanding Delegate to the national convention in December. It looks like Gamma Beta chapter walked off with all the honors for the year.

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Last fall after a football game some of the lads were taking a tour around the host city, Baltimore. As they were passing one particularly large huilding, someone remarked: "We are now passing one of the largest breweries in the United States." To which Howie Grayson murmured: "Why?"

The Columbia River Reclamation Project

By James E. Robins

How would you like to have your land, your house, maybe everything you own slide out from under you and splash into a lake? That is exactly what might happen if your house were situated on the hanks of Lake Roosevelt. the reservoir in back of Grand Coulee Dam, one of the newest and largest of our man-made lakes. This past summer I was at Lake Roosevelt with the Coast and Geodedic Survey. and one of the main purposes of the charts we made was to predict where these slides might occur.

Grand Coulee Dam, the largest concrete dam in the world, is part of the Columbia River Reclamation project, located in northern Washington State. The main purpose of this project is two-fold, to provide water for irrigation. and to provide hydro-electric power. but Lake Roosevelt is also important for the part it will play in transportation and flood control.

Grand Coulee Dam is probably the most ideally situated dam in the world. Geologists tell us that millions of years ago during the melting stage of the ice age a gigantic block of ice was dislodged into the steep walled gorge of the Columbia River, and moved down-stream until it reached a natural hottle-neck at the present day sight of Grand Coulee Dam, where it became wedged between the sheer cliffs on either side. This roaming glacier had formed a massive natural dam, diverting the water from the original Columbia Basin to the west, and spilling it over into the long flat broad hasin which today is known as the Grand Coulec. To show the extent of the water which overflowed from this natural dam it may suffice to say that four waterfalls, all of which are now dry. were carved out of solid rock, and the smallest of them is more than three times greater than the mighty Niagara. The old glacier long ago melted. gradually the river diverted back to its old hasin in the west and flowed away, leaving a perfect natural foundation, and also leaving the Grand Coulee Basin high and dry.

The present day Grand Coulee Dam, which was constructed at the sight of the old glacier. is a project of the United States Bureau of Reclamation. It was inaugurated by Franklin D. Roosevelt in 1933 and the United States accepted it from the contractor in January 1942. In March 1941 two years ahead of schedule two generators, of 10,000 kilowatt capacity each. began operation in the left power house. They were installed as soon as possible in order to provide war industries, such as the Kaiser Aluminum Plant in Spokane and the Atomic Research Center at Hanford, with much needed electric power. The final plans call for eighteen generators of 108,000 kilowat capacity each. nine in the left power house, and nine in the right power house. which will give the project an ultimate capacity of 1,974,000 kilowatts. By the end of the war and with the aid of two generators borrowed from Shasta Dam, Grand Coulee Dam was producing better than one third of its ultimate capacity. Power from the Grand Coulee Plant is distributed over the transmission system of the Bonneville Power Administration.

Grand Coulee Basin comprises more than a million acres of arid, yet fertile, land which with irigation could be very productive, but today only a small part of it is dry farmed. The glacier which provided the first Grand Coulee Dam was a mile across and nearly 830 feet high, allowing the water which it backed up to flow by gravity into the Grand Coulee Basin. The water which it backed up, however, extended onto what is today Canadian soil. To back American water into Canada today would clearly be illegal, therefore the maximum height of Grand Coulee Dam was limited to 550 feet which backs water only to the Canadian border. Hydro-electric power will pump the water from Lake Roosevelt through three tubes some 18 feet in diameter up the 280 feet into the valley where it will be used for irrigation. The Grand Coulee chasm is 52 miles long and from one and one-half to five miles wide supporting at the present time some 30,000 people, but when the entire project is completed it is estimated homes will be provided for some 350,000. Of the 1,200,000 acres of irrigable land 400,000 acres will be irigated by 1950 according to present plans.

Lake Roosevelt extends 50 miles east from the Dam site and then 100 miles north to the Canadian border. Along its northern and western shores lie the Nez Pierce and Spokane Indian Reservations. To the south and east the land is rich with lumber, wheat. fruit, and minerals. Heretofore the richest land, that lying closes to the water, couldn't be exploited because of poor transportation, but now with water transportation available this land can be put into active production. The Coast and Geodedic Survey had a difficult assignment at Lake Roosevelt. In navigation they are usually not interested in anything except shoals and deeps, but here the lake could be dropped 50 feet very easily and anything town to that depth would become a shoal, so much greater precision than usual was

(Continued on page nine)

ALUMNI

This is your page in our magazine. To make it a complete success we need your cooperation. You want to hear about your classmates and they want to hear about you. We are always happy to receive and print all communications, so how about dropping us a line right now. Thanks.

Our Address: Micheleciv, George Washington University, Washington, D.C.

Benjamin C. Cruickshanks, BSinME '20.

Prof. Cruickshanks is one alumnus who would not be lost on the GWU campus of today. He has been here both as a student and faculty member for more than thirty years. He attended George Washington University part time while working at the National Bureau of Standards where he was an assistant physicist. Immediately upon graduation he was offered a position as instructor in the Mechanical Engineering Dept. After an initial three year teaching session, he left our campus to become editor of "The Locomotive", a trade paper published by the Hartford Steam Boiler Inspection and Insurance Co. In addition to editing their paper he was director of their correspondence school course on "Firing". It was during his employment with the Hartford Co. that he took the "famous scale-clogged boiler tube photograph," which is standard equipment in almost all "Power Plant" books. After four years with the Hartford Co., he decided that he would rather get back into a more technical engineering job and rejoined the faculty of GWU. Today Prof. Cruickshanks is Executive Officer of the M.E. Dept.

Almost all engineering students of recent years will remember Prof. Cruickshanks as the man who introduced them to that indispensable little tool of the engineering profession, the slide rule.

Prof. Cruickshanks is a former Varsity baseball player. He was catcher on the 1920 team and reports that they had a very good year. This was one of the first GWU baseball squads. He was coach of the old Engineering Baseball Team (present day students take note) for several years and it is reported by realiable sources that he still has a very good arm today.

Prof. Cruickshanks has been extremely active in the Washington Chapter of the ASME, having served as chairman in 1946-47. He was cited by the General Alumni Association of the University in November 1947 for outstanding service and leadership in the field of engineering education. He is past president of the Sigma Tau Alumni Assoc. and a contributor to their publication, "The Pyramid". He is also past president of the Faculty Club and a member of Sigma Phi Epsilon social fraternity.

John Nygard, BEE '48 is now at M. I. T. working with Prof. John Trump on high voltage electrostatic generators. Part of his studies and research are devoted to the development of high speed mercury pumps for the new 12 MEV generators to be used in nuclear work there. John lives about fifteen miles from the school, but even so his last terms marks were excellent. Congratulations John.

Ford Wheeler, BCE '49 is now working in Chicago.

Bill Sutherland, BCE '49 has accepted a position in Puerto Rico.

Jerry Baker, BCE '48 returned to the campus at the last ASCE meeting with the local sections Junior Forum. They came to advise us on job opportunities in the field.

Among the Alumni returning for the Annual Engineers Ball were Dwin Craig, BS in Eng '48, Vincent Hennessy, BCE '48, Ben Sorin, BME '48, Thomas A. O'Halloran BS in EE '35 and Malcolm Hodges, BEE '48. We were very glad to have you back and hope a fine time was had by all.

ASME

The George Washington University student branch of the American Society of Mechanical Engineers will play host at the Branch Conference of Region 3 on April 1 and 2. Twenty colleges in Maryland, Pennsylvania, Delaware, and New York are expected to send representatives.

The program of events will get under way at 8 o'clock Friday morning with registration at the Washington Gas Light Auditorium. On the schedule for Friday and Saturday mornings will be the reading of competitive papers by the delegates, in which Harry W. Crosswell will represent George Washington. Field trips in the Washington area are planned for the afternoon periods.

The meeting will be climaxed by a luncheon held on Saturday noon at the Annapolis Hotel, official headquarters for the conference. In addition to the entertainment planned, the prizes for the best papers will be awarded at the luncheon.

George Washington students serving as committee chairmen for the conference are B. C. Cruickshanks, Jr., General Chairman; Albert Tinkelenburg, Banquet; J. W. Crupper, Housing; Arthur Elf, Field Trips; W. B. Allison, Welcome and Registration; Ray Juncal, Entertainment; and Kenneth Bennett, Publicity.

LONG PLAYING RECORDS

By LUGI DEVICO

Early phonographs depended on the driving power of the turntable motor to produce sound. The motor turned the record, the groove vibrated the needle, and the needle in turn drove the diaphragm in the throat of the horn. There were many disadvantages in the orthoacoustic type of recording. The grooves had to be rugged, the pick-up stylus had to be large in order to produce a loud acoustic output, and the record had to be turned at high speed to provide sufficient high frequency range.

Because industry has developed high gain electronic amplifiers, dynamic loudspeakers, and sensitive phonograph pickups to the point where they are reliable consumer goods, it is no longer necessary to use a record designed to produce sound directly. The advancement in the fields just mentioned has now afforded closer tolerances and allowed the record to be of the long playing type (LP). There are two factors which enter into the design of LP records; they are speed and grooves per inch. The new long playing records are played at a speed of 33 1/3 RPM as compared with the conventional speed of 78 RPM. There is then a time factor of 78 over 33 1/3, equal to 2.35. The new record can have as many as 260 grooves per inch cut as compared with the conventional 85 to 100 grooves per inch of the 78 RPM record. This time factor is approximately 2.6. When these time factors are taken together there is a resultant time factor of approximately 6.5. The net result is the accomodation of 50 minutes of playing time on both sides of a 12 inch disc as compared with the 8 minutes on the conventional type. The average time for a classical composition is 40 minutes. Evidently one record could replace an album of several discs, save money, save space. and have one fourth the weight. From the consumer's standpoint all these factors are desirable if the recording is of the same quality or better than that to which they are accustomed.

From the geometric considerations, the minimum playing time was found to be obtained when the outside diameter was twice the inside diameter. To use a smaller inside diameter a higher rate of revolution would be required to maintain the same minimum linear velocity at the innermost groove which would result in a decrease of playing time. A larger inside diameter obtained by reducing the number of grooves, would decrease the playing more than the permissible decrease in record speed would increase it. With a twelve inch record the usual limits are an outside diameter of 11.5 inches and an inside diameter of 5.5 inches.

Although at this time the design of the record might be achieved by finding the linear velocity and the tip radius of the stylus necessary to reproduce the required high frequency, it is simpler to arbitrarily decide on a turntable speed (linear velocity). As low a speed as possible is desired. but too low a speed would create serious rumble problems. Since most of the experience has been gained at 33 1/3 RPM, it was chosen. At this speed, on a twelve inch record. 20 minutes of playing time necessitates at least 230 grooves per inch. The nearest practical value is 224 grooves per inch. The peak groove displacement for 224 grooves per inch is .0009 inch and the linear velocity of the innermost groove is 9.6 inches per second.

The wide frequency response of FM broadcasting and of professional wire recordings suggests that improvements in frequency range of records are also in order. To meet this requirement a frequency range of 30 to above 10,000 cycles is desirable.

The manner in which performance is evaluated is by comparison with the 78 RPM records and transcriptions. To establish an analytical basis for comparison, the condition where the radius of reproducing stylus and the minimum radius of the curvature of the recorded wave are equal was arbitrarily chosen as the limiting condition. and the corresponding frequency formed the limiting frequency. The condition is reached when:

$$F_L = V/2\pi(R_{EFF}D)^{1/2}$$

where F_L is the limiting frequency, V is the linear velocity, *Reff* is the effective radius of the reproducing stylus. and D is the deviation. This equation shows that if the deviation were small, the limiting frequency can be very high.

If the frequency is greater than the limiting value. the deviation, for equal radius of needle tip and groove modulation, must be less than maximum. This consideration establishes a usable deviation as a function of frequency. The full deviation is .002 inch for 78 RPM records, .0011 inch for transcriptions and .0009 inch for the long playing records.

Another way to evaluate performance is on the basis of harmonic distortion produced in tracing the grooves. Because of the symmetry of the tracing error, there will be no second harmonic distortation. There will be a third harmonic distortion. In this way it is found that, for the inside groove at any frequency, the relative distortions due to tracing at maximum deviations of the systems are:

$$T78/T_{LP}=5.35 \text{ and } T_{TR}/T_{LP}=1.91.$$

where T78 is the distortion of the 78RPM rec-

(*Continued on page nine*)

AIEE

The March 2, 1949 meeting of the AIEE was for the purpose of the presentation of the student prize papers for district No. 2. The judges were Mr. W. J. Lank, chief electrical engineer of the Potomac Electric Power Co., seceretary-treasurer of the Washington section AIEE. fellow member of the AIEE; Mr. George R. Wilhelm. General plant engineer, Chesapeake and Potomac Telephone Co., member of the AIEE. and Mr. A. T. McClinton, electrical engineer. aircraft electricity division Naval Research Lab. The speeches were judged on four main parts: speaking text, style, introduction and conclusion. and discussion. The paper was to be fifteen minutes long with a five minute discussion period.

The first speaker was Willis Vary who presented a paper on "Peacetime Applications of Wartime Electronic Devices". His speech lasted fourteen and one-half minutes. The paper was about the use of electronic devices in determining if nerves and teeth were living or dead by electrical shock methods. He also told of the new methods of electronic air purification and cooking and mentioned the radar that is used for blind landings and storm tracking.

The second speaker was John Dallas who spoke on "Marine Electric Drives". He told about the first Navy vessel to have an electric drive, the Carrier Langley. He mentioned the three main types of electric drives: A.C. Turbo-electric Drive; A.C. Diesel Drive, and D.C. Diesel Electric Drive. He showed the schematics of the different drives and how they were controlled.

The third speaker was William Klein. He spoke on "Review of Electrical Servo Systems". He mentioned the fact that they were originally devised for ship rudder control, and later used for heavy bomber control. The system is so connected that the element being controlled will travel just as far as required and stop. Hunting in the control element would probably cause disastrous effects. He said the lay definition of the servo-systems is. "a system where less energy is used by the controlling element than is used by the controlled element." He explained the different types of systems by using slides.

After the presentation of the papers. the treasurer gave his report, stating there is $38.00 in the treasury. It was decided by unanimous vote to take the money from the treasury to pay for the tickets to the annual banquet to be held in April. Announcement was made that election of officers will be held at the next meeting.

ASCE

The ASCE held its second meeting of the current semester on March 2, when the members of the chapter and its guests had the pleasure of hearing Mr. Ralph Furhman. Superintendent of the Blue Plains Sewage Disposal Plant and School of Engineering lecturer. speak on the many advantages offered by membership in the parent society of the ASCE. Some of the more important points were the professional recognition of society members and the work of disseminating knowledge of the latest engineering developments.

The society was also privileged to hear short talks about their work by Mr. Heron. President of the Junior Forum of the ASCE, and various members of the organization which he leads. Represented were engineers from the Bureau of Reclamation. the Turner Construction Co., the U. S. Navy, and a variety of other branches of the government and fields of private industry. An informal discussion with individual speakers concerning placement opportunities completed a most enlightening evening.

E. E. LOVE HANDBOOK EDITIONS

By E. H. Mullins

IF she wants a date — Meter
IF she comes to call — Receiver
IF she wants an escort — Conductor
IF you think she's picking your pocket — Detector
IF she's slow on comprehension — Accelerator
IF she goes up in the air — Condenser
IF she's hungry — Feeder
IF she's a poor cook — Discharger
IF she eats too much — Rectifier
IF her hands are cold — Heater
IF she fumes and sputters — Insulator
IF she wants a holiday — Transmitter
IF she's narrow in her views — Amplifier
IF she's a pest — Exterminator

(Ed Note: Mr. Mullins is a married man, may be that has some bearing on the content of the above.)

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A citizen was walking up the street when he was buttonholed by a character who said: "Shay! Can you tell me where to find Alcoholicsh Anonymush?"

"Why? Do you want to join?"

"Nope. Wanna resign."

Economy In Pig Iron Production

By HENRY E. HUTTO

The process of producing pig-iron, the product giving rise to the rapidly advancing machine age of today, is carried out by smelting iron ore in a blast furnace. We all have a working knowledge of its function and general operation, but in order to establish a basis for a comprehensive comparison of present-day smelting methods and those to be expected in the future, I will review some of the principal features of a typical blast furnace. It is a huge steel jacketed, brick-lined tower in which many of the impurities in iron ore are separated from the molten iron. In operation, the charge, consisting of about 60% iron ore and scrap iron, 25% coke, and 15% limestone, is fed in at the top of the stack and gradually works down toward the bottom. Heated air is blown in through tuyeres near the bottom of the furnace under pressure of about 15 psi. This in combination with the coke, produces the heat and reducing agents necessary for smelting the charge materials into iron, while limestone, acting as a flux, carries impurities away in the form of molten slag.

It was estimated that the 253 blast furnaces in operation in the United States at the end of 1945 had a total rated capacity of over 68,000,000 tons per year. The average blast furnace has a capacity of about 700 tons of pig iron per day and the larger ones have a capacity of 1600 tons per day.

From these facts it can be seen that the demand placed upon our natural resources in coke and iron ore is tremendous. At the same time our supply of these raw materials is depreciating in quality. The inevitable result is that methods and equipment will have to be developed to utilize poorer grade raw materials. Work is being carried out to attain such an end, but smelting equipment represents a huge capital investment, consequently steel producers are interested in keeping the cost of reequipping for improved processes as low as possible.

Although several new methods have been tried. Julian M. Avery, a chemical engineer, introduced one of the most prominent ones in operating present day blast furnaces at higher internal pressures. The basic feature of the pressure techinique, which is known as "high top pressure blowing," is a valve, or some other form of throttle, to block the flow of flue gasses out of the furnace, without restricting the air input passages. As a result, pressure is built up inside the furnace to an extent limited by the capacity of the blower.

Throttling does two things to a furnace. First, because the usual draft is blocked, it sharply reduces gas velocity through the furnace. Second, it distributes the gas more uniformly through the dense mass of furnace charge. When gas velocity is reduced, more air can be blown, more ore smelted, finer ore used, and more iron made, without generating excessive flue dust. Furthermore, with reduced gas velocity and improved gas distribution, the carbon monoxide has favorable conditions for giving up more chemical heat in reacting with iron ore to form carbon dioxide. More efficient use is made of the flue gasses and coal consumption is decreased.

Republic Steel already has in operation two low-pressurized furnaces, and is pressurizing five additional ones this year. Two of them are to have a pressure 20 psi above that in the conventional furnace. The two already in operation have a pressure of about 10 psi above normal. At this pressure, with the present day capacity of blowers, 10 to 20 percent more air can be blown. This results in a rise of up to 15% in the amount of iron produced from rather lean ore containing 48 to 50 percent iron with a 10 to 15 percent saving of coke and 30 to 70 percent reduction of the flue-dust loss. Higher pressures will further enlarge these gains.

Most furnaces can be converted to pressure operation in less than a week for about $125,000, one percent of the present ten million dollar cost of a new furnace. The changes required are essentially devices for throttling exhaust gases and for sealing the pressurized furnace. Since it has long been the practice to install extra blowing capacity in case a fire must be stimulated, the majority of conventional furnaces already have adequate blowers.

An interesting feature of "high top pressure blowing" of secondary importance, but still worthy of consideration, is the experimentation being made with the throttled flue gasses. In conventional furnaces recovery of the exhaust gas yields enough heat to preheat the blast. For the large pressurized furnace it is believed that, in addition, power may be generated by throttling the exhaust gases into a gas turbine and then supplied to the blowers, as well as other plant installations. Estimates, for one Youngstown, Ohio furnace, having an extra pressure of 10 psi, are that a throttling turbine might recover 2,000 kw. A clear profit in power.

In coming years, the United States will have an increasing need for the various advantages of economical smelting. By making possible the production of more iron from poorer raw material, it may be able to solve, at least partially, the problem of future shortage in iron and steel.

FINAL EXAMINATIONS

As we see it, the principal reasons for the existence of final examinations today are: (1) precedent, (2) a review of the term's work. (3) a means of evaluating the success of the student and the teacher.

PRECEDENT: From the fact that there has always been the final examination, it could be falliciously contended that that is the valid reason for its continued existence—". . . otherwise, why would it have been continued for so long . . . ?" To explain the erroneous reasoning involved here borders on the trite; it suffices merely to remark that we appreciate all that has been created and handed down to us because precedent was by-passed and investigation substituted in its place.

REVIEW: The final examination, in too many cases, has come to be viewed—both by educators and students—as the ultimate objective of a course. As such, it is an artificial stimulus for the learning process. Thus what in theory should provide an incentive for a thorough review, deteriorates to a situation of sleepless nights of cramming. Furthermore, experience teaches a student to master not only broad concepts, but to memorize a mass of material which. depending on the whims of an instructor, the latter might deem important enough to include on the examination. A great portion of the necessity for cramming is supplied to the student; and it is common knowledge that that material which is studied under conditions of mental duress and physical fatigue is not long retained.

THE FINAL EAMINATION: The final examination is the club which forces the student to attempt a retention of textbook material plus page after page of notes. upon whose most important sections he has already been examined. As we see it, the regular examinations during the semester achieve all the purported objectives of the final examination.

EVALUATION: A further cause for the cramming process described above is to be found in the ridiculously magnified importance placed upon the results of the final examination by the educators. When presumably the same material handled in class and done for homework is given during a "very important" three-hour examination, then the penalization (and more important. the results of the penalization) assumes in some manner a very great importance. In the evaluation of the final examination. it is the student who bears the brunt (entirely) of the consequences. We wonder how much of a student's record, which he must present to a prospective employer, indicates an evaluation of the student's work throughout an entire term, and how much is an evaluation of final examination results.

The subject of evaluation is more a subject of the marking system, a topic which we wish to avoid in these lines because we have not set out here to discuss this facet of the educational system. We believe that the final examination (coupled with the marking system) serves more as a convenience for educators than as a tool for the benefit of students.

CONCLUSION: On all three bases, the justification for the existence of the present system of final examinations seems to reveal a basically unsound structure. We suggest that a serious study be made to produce a means of accomplishing all (or most) of the basic aims of a final examination without perpetuating the weaknesses of the present system.

One suggestion along this line is that the two weeks period set aside for examinations could be used to greater advantage by both students and teachers as a period devoted solely to review in the classroom. Ample time would be provided to go over the term's work, for the important items to be reviewed and discussed, and for questions to be answered. Surely this would serve as a more adequate review! As for evaluation— the teacher should have sufficient evidence in the form of examinations given throughout the term covering units of course material to determine how much a student understands, and how successfully the teacher has done his job.

(Editor's Note: This editorial was written by DAVID STEIN for *The Michigan Technic*. Although there have been no great rumblings over final examinations at George Washington, we felt, with the ever-increasing importance being put on "progressive" teaching, that herein was at least good food for thought.)

Kenny Brown has no respect for age unless it's bottled.

———★———

Love makes the world go around, but so does a good swallow of tobacco juice.

———★———

"Your girl is spoiled. isn't she?"
"No. it's just the perfume she's wearing."

(*Continued from page three*)

called for. At the Dam there is a seaplane base, and seaplanes can easily make the hop from Seattle. There is also a small fleet of pleasure cruisers operating on the lake.

This past year the whole Columbia Valley has been ravaged by floods which caused considerable damage. Lake Roosevelt with its 127 square mile surface can aid immeasurably in controling rampaging waters.

In conclusion, it would seem that the future of the Columbia River Reclamation projects is well defined. Coulee Dam will produce electricity by the millions of killowatts to supply industries and pump water for irrigation in the Grand Coulee Basin, and Lake Roosevelt will become a water highway of the Pacific Northwest. But other things are happening too, things that you can't put your finger on, but that might mean disaster. The old timers will swear that the climate is changing, and it could be connected with the awful floods they have experienced this past year. The land always was unstable and now with the terrfic pressure due to tons of water it is starting to shift, with whole banks sliding off and splashing into the lake. Geologists predicted earthquakes, and engineers designed for them by cushioning the dam, but there was something else they could not design for. They could only predict that the water might force its way out, and, by forming a new underground channel, by-pass the dam entirely. The lake is slowly filling up with mud brought in by land slides, and by the deposits of the fast flowing Columbia and Pend Orielle rivers, until someday it may be just a trickle of water over an oozy mud filled hole. Just how long it may take, the engineers will try to discover by comparing the Coast Survey Charts of '48 with the Army Photogrametric charts of '38. There is, however one situation for which a remedy has been found. Boulders have been caught by the under-tow at the base of the dam, and are slowly but surely battering the footing to pieces. Next Spring a huge concrete diving bell will descend on them and pulverize them so that some day they may make the coarse aggregate to replace the damage they have done.

———★———

An empty whiskey barrel is like Hades because it's the place of departed spirits.

———★———

"So you've been to college, eh?"

"Yeah."

"How high can you count?"

"Two, three, four, five, six, seven, eight, nine, ten, jack, queen, king, ace."

(*Continued from page five*)

ord, TTR is the distortion of a transcription, and TLP is the distortion of the longplaying record. Were it not that the maximum displacement of the groove was rarely required at high frequencies (above limiting) the tracing distortion from all three systems would be excessive.

The phonograph pickups require very low force at their stylus and high sensitivity. Vinylite as the recording base reduces the surface noise so that even with the small recorded groove deviations, the signal to noise ratio is acceptable. The use of light weight pickups further improves with an acceptable background noise level is obtained. The development of suitable pickups was part of the overall program. The needle radius tracking force of 6 grams is the most favorable.

The rapidity with which suitable pick-ups have been developed commercially verifies the basic assumption that the art has progressed to the point that this new approach to recording is justified.

———★———

"What's the difference between an accountant and an engineer?"

"An engineer is a darn fool running around with a slide-rule, whereas an accountant doesn't own a slide-rule."

———★———

Janie: What did you get in your stocking for Christmas?

Susie: Nothing but a runner.

Janie: Well, what did you expect—a pole vaulter?

———★———

"Oh, Doctor," said the young lady, will that scar show?"

"That, madam, is entirely up to you."

Art Machlin is so lucky that he can take a penny to class and still make 97 on a true and false exam.

———★———

Out of the last war came the anecdote about the British blockade. It seems the Germans named their ships after jokes so the British wouldn't see them.

ALUMNI

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Engineers Banquet

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